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Present climate simulation over Korea with a regional climate model using an one-way double-nested system

E.-S. Im(1), E-H. Park(1), W.-T. Kwon(1) and F. Giorgi(2)

(1) Climate Research Lab., METRI, Korea Meteorological Administration, (2) Abdus Salam ICTP, Trieste, Italy (esim@metri.re.kr / Phone: +02-2-846-2852)

[Abstract]

This study investigates the capability of the regional climate model RegCM3 to simulate surface air temperature and precipitation over the Korean Peninsula. The model is run in one-way double nested mode, with a 60 km grid point spacing “mother” domain encompassing the eastern regions of Asia and a 20 km grid point spacing nested grid covering the Korean peninsula. The simulation spans the three- year period of 1 October 2000 through 30 September 2003 and the boundary conditions needed to run the mother model are provided from the NCEP reanalysis of observations. The model results are compared with a high density station observation dataset to examine the fine scale structure of the surface climate signal. The model shows a good performance in capturing both the sign and magnitude of the seasonal and inter-annual variations of the surface variables both over Asia as a whole and over the Korean peninsula in the nested system. Some persistent biases are however present. Surface temperature is systematically underestimated, especially over mountainous regions in the warm season. While results averaged over the Korea region did not differ much between the mother and nested models, the latter improved the spatial distribution of temperature in both seasons and precipitation in the winter season. In all these cases the improvement was due to a better representation of topographical features. The simulated precipitation over the mother domain successfully reproduces the broad spatial pattern of observed precipitation over East Asia along with its seasonal evolution. On the other hand, fine scale details from nested results show a varying performance for the different individual years. For summer precipitation, both the mother and nested models produced a relatively good simulation in 2001, displaced the location of the observed maximum in 2002 and entirely missed the occurrence of large precipitation

amounts over Korea in 2003. This latter problem was due to an underestimation of the northward extent of the monsoon rain band. In our experiments, the nested model did not produce an obvious improvement in the simulation of summer precipitation. This is because summer precipitation over Korea is not strongly forced by topography but it is more determined by stochastic and relatively little predictable processes such as the occurrence of monsoon convective systems and tropical storms. In addition, since our region is of relatively small size, an even minor shift in the location and track of convective storm systems may result in relatively large model errors. Moreover, fail in reproducing in summer precipitation of 2003 might be associated with driving forcing using NCEP/NCAR reanalysis. We find a considerable discrepancy between the CMAP and NCEP precipitation in summer season of 2003 (not shown), and simulated precipitation is in better agreement with the NCEP precipitation fields. For this reason a much larger ensemble of simulations is needed to fully evaluate the performance of the nested system for summer monsoon precipitation over Korea.

Despite this last conclusion, we assess that the regional double nesting provides a useful tool to produce fine scale climate information over the Korean Peninsula and we are in the process of carrying our longer simulations to better evaluate the added value of this procedure. In particular, with longer simulations we will be able examine in more detail issues pertaining the simulation of extreme events.

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